

CLAIM AMENDMENTS

1. (Currently Amended) A transformer inrush current elimination system for suppressing an inrush current that is generated as a transition current when a three-phase transformer is connected to a three-phase power supply via a three-phase circuit breaker, comprising:

source voltage measuring means ~~adapted to measure~~ for measuring a source voltage of ~~any~~ one phase to be used as a standard phase among the three-phases of the three-phase power supply;

transformer voltage measuring means ~~adapted to measure~~ for measuring a transformer voltage of each of the three-phases;

a residual flux calculating portion ~~adapted to calculate~~ for calculating a residual flux of each phase, using the transformer voltage of each phase measured by said transformer voltage measuring means, before and after a open command input time;

a closing order determining portion ~~adapted to determine a~~ for determining which phase ~~having~~ has the ~~greatest absolute value of the~~ residual flux with largest magnitude, calculated by the residual flux calculating portion, ~~to be as~~ a first closing phase among the three-phases;

a target closing phase determining portion ~~adapted to determine~~ for determining target closing phases of the three ~~closing~~ phases, wherein,

regarding the first closing phase, said target closing phase determining portion calculates a closing phase having ~~the smallest value of an~~ energization flux error ~~that, which~~ is an absolute value of ~~the~~ maximum error between a constant flux value and a residual flux value at a connection input point, based upon the residual flux of the first closing phase, and a preliminarily given pre-arc characteristic and closing time deviation characteristic of the three-phase circuit breaker, ~~by using a 0~~ zero degree phase of the standard phase as a reference point, and sets the ~~resultant-calculated~~ closing phase ~~to be a~~ so calculated as the target closing phase of the first closing phase, and

~~wherein,~~ regarding ~~the rest two~~ second and third closing phases, said target closing phase determining portion calculates a closing phase having the smallest ~~value of the~~ energization flux error ~~in the case of when~~ the residual flux ~~being 0~~ is zero, based upon the preliminarily given pre-arc characteristic and closing time deviation characteristic of the three-phase circuit breaker, ~~by using the 0~~ zero degree phase of the standard phase as a reference point, and sets the ~~resultant-calculated~~ closing phase ~~phase to be a~~ phases so

calculated as target closing phase phases of each of the rest two second and third closing phases;

a target closing time determining portion ~~adapted to calculate a~~ for calculating time required from the reference point to the target closing phase of the first closing phase so that the ~~calculated time~~ calculated is determined to be a target closing time of the first closing phase, and ~~calculate~~ for calculating a sum of the time required from the reference point to the target closing phases of the ~~rest two second and third closing phases~~ and a delay time corresponding to an ~~integral integer~~ multiple of a predetermined cycle of the three-phase power supply so that the ~~calculated sum~~ calculated is determined to be a target closing time of each of the ~~rest two second and third closing phases;~~ and

a controlled closing portion which, upon receipt of a closing command, outputs a controlled closing signal to the three-phase circuit breaker so that each phase is contact-closed at the target closing time of each phase calculated by said target closing time determining portion, ~~by using the 0~~ zero degree phase of the source voltage of the standard phase ~~inputted input~~ from the source voltage measuring means as a reference point, wherein said three-phase transformer has a primary winding having a star connection with a neutral ground and one of a secondary or and tertiary winding having a triangle connection, and said three-phase circuit breaker connects the three-phase transformer to the three-phase power supply by ~~the~~ closing and disconnects the transformer from the three-phase power supply by ~~the~~ opening.

2. (Currently Amended) A transformer inrush current elimination system for suppressing an inrush current that is generated as a transition current when a three-phase transformer is connected to a three-phase power supply via a three-phase circuit breaker, comprising:

source voltage measuring means ~~adapted to measure~~ for measuring a source voltage of ~~any one a first~~ phase to be used as a standard phase among the three-phases of the three-phase power supply;

transformer voltage measuring means ~~adapted to measure~~ for measuring a transformer voltage of the standard phase;

a controlled opening portion which, upon receipt of a opening command, simultaneously outputs controlled opening signals to ~~the rest two second and third phases other than of the standard three-phase power supply~~ and, after a predetermined time lapse therefrom, ~~which~~ outputs a controlled opening signal to the standard phase;

a residual flux calculating portion ~~adapted to calculate~~ for calculating a residual flux of the standard phase, using the transformer voltage of the standard phase measured by said transformer voltage measuring means, before and after an opening command input time;

a target closing phase determining portion ~~adapted to determine~~ for determining target closing phases of the three ~~closing~~ phases, wherein,

regarding the standard phase, said target closing phase determining portion calculates a closing phase having ~~the smallest value of an~~ energization flux error ~~that, which~~ is an absolute value of ~~the~~ maximum error between a constant flux value and a residual flux value at a connection input point, based upon the residual flux of the standard phase, and a preliminarily given pre-arc characteristic and closing time deviation characteristic of the three-phase circuit breaker, ~~by using a θ zero degree phase of the standard phase as a reference point, and sets the resultant-calculated closing phase so be~~ so calculated as a target closing phase of the standard phase, and

~~wherein,~~ regarding the ~~rest two~~ second and third phases, said target closing phase determining portion calculates a closing phase having the smallest ~~value of the~~ energization flux error ~~in the case of when the residual flux being θ is zero,~~ based upon the preliminarily given pre-arc characteristic and closing time deviation characteristic of the three-phase circuit breaker, ~~by using the θ zero degree phase of the standard phase as a reference point, and sets the resultant-calculated closing phase to be~~ so calculated as a target closing phase of each of the ~~rest two~~ second and third phases;

a target closing time determining portion ~~adapted to calculate a~~ for calculating time required from the reference point to the target closing phase of the standard phase so that the ~~calculated time~~ time calculated is determined to be a target closing time of the standard phase, and ~~calculate~~ for calculating a sum of the time required from the reference point to the target closing phases of the ~~rest two~~ second and third phases and a delay time corresponding to an ~~integral~~ integer multiple of a predetermined cycle of the three-phase power supply so that the ~~calculated sum~~ calculated is determined to be a target closing time of each of the ~~rest two~~ second and third phases; and

a controlled closing portion which, upon receipt of a closing command, outputs a controlled closing signal to the three-phase circuit breaker so that each phase is contact-closed at the target closing time of each phase calculated by said target closing time determining portion, ~~by using the θ zero degree phase of the source voltage of the standard phase inputted input~~ from the source voltage measuring means as a reference point, wherein said three-phase transformer has a primary winding having a star connection with a neutral ground and one of a secondary ~~or~~ and tertiary winding having a triangle connection, and said

three-phase circuit breaker connects the three-phase transformer to the three-phase power supply by ~~the~~ closing and disconnects the transformer from the three-phase power supply by ~~the~~ opening.

3. (Currently Amended) A transformer inrush current elimination system for suppressing an inrush current that is generated as a transition current when a three-phase transformer is connected to a three-phase power supply via a three-phase circuit breaker, comprising:

source voltage measuring means ~~adapted to measure~~ for measuring a source voltage of ~~any one~~ a first phase to be used as a standard phase among the three-phases of the three-phase power supply;

transformer voltage measuring means ~~adapted to measure~~ for measuring a transformer voltage of each of the three-phases;

a residual flux calculating portion ~~adapted to calculate~~ for calculating a residual flux of each phase, using the transformer voltage of each phase measured by said transformer voltage measuring means, before and after ~~a~~ an opening command input time;

a closing order determining portion ~~adapted to determine~~ for determining a closing order of the three-phases, wherein, regarding each of the three-phases, said closing order determining portion calculates a minimum energization flux error and a closing phase having the smallest value of the energization flux error ~~that~~, which is an absolute value of the maximum error between a constant flux value and a residual flux value at a connection input point, based upon the ~~calculated~~ residual flux calculated, and a preliminarily given pre-arc characteristic and closing time deviation characteristic of the three-phase circuit breaker, ~~by~~ using a ~~0~~ zero degree phase of the standard phase as a reference point, and sets the ~~resultant calculated~~ closing phase having the smallest minimum energization flux error to be a first closing phase among the three-phases;

a target closing phase determining portion ~~adapted to determine~~ for determining target closing phases of the three-phases, wherein,

regarding the first closing phase, said target closing phase determining portion calculates a closing phase having the smallest value of the energization flux error of the first closing phase, calculated by said closing order determining portion, and sets the ~~resultant calculated~~ closing phase ~~to be~~ so calculated as a target closing phase of the first closing phase, and

~~wherein,~~ regarding the ~~rest two~~ second and third closing phases, said target closing phase determining portion calculates a closing phase having the smallest value of the

energization flux error ~~in the case of when~~ the residual flux ~~being 0~~ is zero, based upon the preliminarily given pre-arc characteristic and closing time deviation characteristic of the three-phase circuit breaker, ~~by using the 0 zero~~ degree phase of the standard phase as a reference point, and sets the ~~resultant-calculated~~ closing phase ~~to be~~ so calculated as a target closing phase of each of the rest two second and third phases of the three-phase power supply;

a target closing time determining portion ~~adapted to calculate a~~ for calculating time required from the reference point to the target closing phase of the first closing phase so that the ~~calculated~~ time calculated is determined to be a target closing time of the first closing phase, and ~~calculate~~ for calculating a sum of the time required from the reference point to the target closing phases of the ~~rest two~~ second and third phases and a delay time corresponding to an ~~integral~~ integer multiple of a predetermined cycle of the three-phase power supply so that the ~~calculated sum value~~ sum calculated is determined to be a target closing time of each of the ~~rest two~~ second and third phases; and

a controlled closing portion which, upon receipt of a closing command, outputs a controlled closing signal to the three-phase circuit breaker so that each phase is contact-closed at the target closing time of each phase calculated by said target closing time determining portion, ~~by using the 0 zero~~ degree phase of the source voltage of the standard phase inputted input from the source voltage measuring means as a reference point, wherein said three-phase transformer has a primary winding having a star connection with a neutral ground and one of a secondary ~~or~~ and tertiary winding having a triangle connection, and said three-phase circuit breaker connects the three-phase transformer to the three-phase power supply by ~~the~~ closing and disconnects the transformer from the three-phase power supply by ~~the~~ opening.

4. (Currently Amended) The transformer inrush current elimination system according to claim 1, further comprising:

main circuit current measuring means ~~adapted to measure~~ for measuring a main circuit current of each of the three-phases; and

a closing time calculating portion ~~adapted to calculate~~ for calculating a measured closing time required from ~~a point of~~ outputting of a controlled closing signal of each phase to ~~a point of~~ the closing, ~~by using a controlled closing signal of each phase outputted output~~ from the controlled closing portion, the main circuit current of each phase being measured by said main circuit current measuring means, and preliminarily given voltage resistant

characteristics of each phase, wherein said controlled closing portion corrects the controlled closing signal based upon the ~~measured~~ closing time measured.

5. (Currently Amended) The transformer inrush current elimination system according to claim 2, further comprising:

main circuit current measuring means ~~adapted to measure~~ for measuring a main circuit current of each of the three-phases; and

a closing time calculating portion ~~adapted to calculate~~ for calculating a measured closing time required from ~~a point of~~ outputting of a controlled closing signal of each phase to ~~a point of~~ the closing, ~~by~~ using a controlled closing signal of each phase ~~outputted~~ output from the controlled closing portion, the main circuit current of each phase being measured by said main circuit current measuring means, and preliminarily given voltage resistant characteristics of each phase, wherein said controlled closing portion corrects the controlled closing signal based upon the ~~measured~~ closing time measured.

6. (Currently Amended) The transformer inrush current elimination system according to claim 3, further comprising:

main circuit current measuring means ~~adapted to measure~~ for measuring a main circuit current of each of the three-phases; and

a closing time calculating portion ~~adapted to calculate~~ for calculating a measured closing time required from ~~a point of~~ outputting of a controlled closing signal of each phase to ~~a point of~~ the closing, ~~by~~ using a controlled closing signal of each phase ~~outputted~~ output from the controlled closing portion, the main circuit current of each phase being measured by said main circuit current measuring means, and preliminarily given voltage resistant characteristics of each phase, wherein said controlled closing portion corrects the controlled closing signal based upon the ~~measured~~ closing time measured.